The Home Modification of Cow's Milk

"What can equal the glory and joy of the husbandman as he follows his plough through the furrows of warm rich soil?"

THE

HOME MODIFICATION

OF

COW'S MILK

BOSTON, MASS.
MELLIN'S FOOD COMPANY
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THE HOME MODIFICATION OF COW'S MILK

IT is agreed by all authorities that fresh cow's milk must furnish the basis of operations in preparing a substitute for human milk. Cow's milk, however, even when fresh and pure, is, in its undiluted state, of such a nature that the infant cannot digest it, the difficulties arising from the large amount and peculiar properties of the casein. Casein being present in too large a proportion in cow's milk to be digested by the infant's stomach, the proportion of casein must be reduced by dilution with water.

Necessity for Modification.

There is a wide difference, moreover, between the properties of and the results produced by the casein of human milk, on the one hand, and the casein of cow's milk, on the other. The casein of mother's milk, when coagulated by the acids of the stomach, forms a soft, flocculent clot, readily disintegrated, easily digested. The casein of unmodified cow's milk, on the contrary, is digested with difficulty, and, when coagulated in the infant's stomach, forms tough, coherent curds which cause constipation and indigestion.

Properties of Casein.

Mother's milk when received by the infant is alkaline in reaction. Cow's milk, on the other hand, though it may be neutral in reaction or, at the best, only slightly alkaline when

Mother's Milk Alkaline.

drawn from the udder, soon, from exposure to the air, loses its alkalinity and shows an acid reaction.

F. HOWARD HARRIMAN.

As a result of reducing the amount of casein in cow's milk by dilution with water, the carbohydrates, originally less in amount than in mother's milk, become still further reduced and the deficiency must be made up by the addition of a suitable sugar.

Effects of Dilution.

Dilution of cow's milk with water also decreases the proportion of fat, a deficiency which must be overcome by the use of top milk or cream, in amounts to be determined by the needs of individual cases.

These differences suggest the following :—

RULES FOR THE MODIFICATION OF COW'S MILK

Fundamental Rules for Modification.

1. Reduce the proportion of casein.
2. Soften the casein in order to make it more easily digestible and to arrest its tendency to form tough and tenacious curds.
3. Make the milk alkaline.
4. Increase the carbohydrates, originally insufficient in amount and made still more so by the necessary dilution.
5. Adapt the quantity of fat to the individual case.

JAY FRED LOWDEN.

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"Smoothly and lightly the golden
Seed by the sower is scattered."

REDUCE THE PROPORTION OF CASEIN

THE dilution of cow's milk with pure water is the best and most practical way to reduce the proportion of casein. Different proportions of milk and water must, however, be used, in order that, as the child grows, the proportion of nutritious elements may be increased. On account of the difference in the character of the proteids in cow's milk and the proteids of human milk, varying proportions of milk and water must be used according to the age of the child. That there may be the proper amount of proteids in the food of a child two weeks old about three parts of water to one of milk must be taken, while to have the right amount of proteids for a child six months of age, the proportions are reversed and one part of water to three of milk is approximately the correct ratio.

Proportion of Proteids.

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"And the maize field grew and ripened,
Till it stood in all the splendor
Of its garments green and yellow."

SOFTEN THE CASEIN

WHAT is the best way to modify the casein that it may be more digestible, and that its tendency to form tough and tenacious curds may be arrested?

One method of modifying milk is by the addition of milk sugar. Other methods make use of starchy products, but when milk is modified with *Mellin's Food* the casein is softened and attenuated by the maltose and dextrine in the Mellin's Food.

Attenuation of Casein.

Milk sugar is incapable of favorably affecting the digestive power of the stomach, while dextrine, present in large quantities in Mellin's Food, being itself a peptogen, facilitates the secretion of pepsin and thereby increases the digestive power.

Dextrine a Peptogen.

An attempt to soften casein by means of a starchy product will not give the desired result, because starch is insoluble and has no softening action on the casein. The result is a mechanical mixture only. Furthermore, for infants of tender age the introduction of starch into the stomach is unwise, as young infants do not have the power of digesting starch.

Those who have used milk sugar for the modification of milk have discovered that the quantity of milk which, when combined with water and milk sugar, can be assimilated by the infant, is so small that it gives an amount of proteids

Modification of Casein.

ROBERT F. GRADY, JR.

much less than is needed for the proper nourishment of the child. There is no such complaint from those who use Mellin's Food. The child that is fed on milk modified with Mellin's Food can digest with ease the necessary amount of proteids. That Mellin's Food *really* modifies milk, while milk sugar does not, is the explanation of these two facts.

The addition of Mellin's Food softens the casein and makes it less likely to cause constipation by preventing the formation of hard, cheesy masses, but the addition of milk sugar produces no such effect.

Occlusion.

When milk becomes sour, or when it is acted upon by rennet, it coagulates and the casein separates in clots. Many other substances, if present in the milk at the time this action takes place, are in part occluded and combined with the casein. Professor Leeds gives quantitative results of the amounts of various substances thus carried down. When milk is mixed with a solution of Mellin's Food and the mixture coagulated, a portion of the Mellin's Food is occluded and the result of a quantitative test shows that about thirty per cent of the weight of the precipitate under such circumstances is Mellin's Food.

TION OF COW'S MILK

It has also been found that if the milk and Mellin's Food are mixed and allowed to stand several hours the casein is then even more digestible, or, in other words, more casein will be digested in a given time, thus showing that the Mellin's Food *actually modifies the character* of the casein.

Sufficient time for Action

Repeated experiments made with Mellin's Food and milk on the one hand, and with milk sugar and milk on the other, show that casein occludes more than twice as much Mellin's Food as it does of milk sugar. The occluded Mellin's Food retains, moreover, its characteristic solubility; when it is dissolved by the juices of the stomach it leaves the casein soft, flocculent, sponge-like; easily permeated by the digestive juices and incapable of existing as a tough, tenacious curd.

Actual Modification.

THE MASON TRIPLETS

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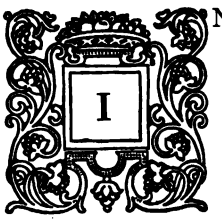
"And now came the reapers, sturdy and strong,
To gather the waving grain."

TION OF COW'S MILK

MAKE THE MILK ALKALINE



N many methods of modification of cow's milk, the desired alkalinity is obtained by lime-water; in others bicarbonate of soda is used. In modification with Mellin's Food we have bicarbonate of potassium. *Natural Alkali.* If we inquire which alkali is the most natural one, *i. e.*, which one is present in greatest quantity in human milk, there can be but one answer — bicarbonate of potassium.

The relative amount of potassium salts is greater in woman's milk than in cow's milk. (Leeds.)

In Harrington's analysis of the ash of human milk, the proportion of total lime salts is 30.24 per cent; of potassium salts, 43.85. The *alkali* present in greatest quantity in the *ash of human milk* is carbonate of *potassium.* Potassium salts predominate largely over the other bases in the mineral constituents or ash of the blood corpuscles and of muscular tissue; potassium phosphate is present in large proportion, while lime salts exist only in small amounts. *Predominance of Potassium.*

A solution of lime-water freshly made is of definite strength, but if used, a little to-day, a little to-morrow, and more on succeeding days, until half the original amount is gone, the strength of the remaining half is by no means equal to that of the original solution. The lime-water has been slowly

F. SUMNER WARREN.

Instability of Lime Water.

and steadily absorbing from the air carbon dioxide, which has united with the calcium of the lime-water. As a result of the union there has been formed and precipitated calcium carbonate, common chalk, a compound absolutely insoluble in water and therefore incapable of being redissolved by the solution. Bicarbonate of potassium, however, whether in solution or in the form of a dry powder, is permanent in composition and invariable in strength.

Lime Salts Insoluble.

Combinations of lime with the fatty acids, such as butter fats, are insoluble bodies. When the gastric juice has neutralized the alkalinity of the lime-water, the result is chloride of calcium. Combinations of potassium with the fatty acids, however, are bodies soft and readily soluble in water, and the result of the neutralizing action of the gastric juice upon bicarbonate of potassium is chloride of potassium, analogous to common salt. If we add to one specimen of milk a weak solution of chloride of calcium, and to another, one of chloride of potassium, we find, on adding a solution of rennet, that the potassium salt causes the milk to coagulate in softer and more soluble clots than are those produced by the calcium salt.

Softer Curds with Potassium.

Potassium salts are less liable to cause constipation than lime salts. (Cheadle.) *Prevention of Constipation.*

Potassium salts are more effective in preventing the discharge of hard curds than lime salts. (Roberts.)

From the foregoing we summarize these facts: —

1. In the ash of human milk the alkalinity depends upon the presence of potassium salts and *not* of lime salts.
2. Potassium bicarbonate is permanent in composition, while lime-water is often of deficient alkalinity and always variable.
3. Potassium salts of the fatty acids are soft and soluble. *Lime salts* are *insoluble.*
4. Potassium chloride causes a slower coagulation and less tough curds than do lime salts. *Slow Coagulation.*
5. Potassium salts are less likely to cause constipation than are lime salts.

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"Turn, turn, O mill! Turn round and round,
Without a pause, without a sound."

INCREASE THE CARBOHYDRATES

BY the dilution of cow's milk with water in order to lessen the proportion of casein, the small percentage of carbohydrates becomes still less. This deficiency must be made up. In many attempts at modification of cow's milk, the deficiency of carbohydrates is overcome by the addition of milk sugar. In the modification by Mellin's Food the needed carbohydrates are supplied by the maltose and dextrine in the Mellin's Food.

Deficiency of Carbohydrates.

The carbohydrates by their oxidation keep up the supply of heat in the system — not that this is their sole office, but it is probably their principal function.

Composition of Carbohydrates.

Which of the sugars, milk sugar or maltose, is capable of supplying the greatest heat? The chemical formulas are identical.

Milk sugar . . . $C_{12} H_{22} O_{11} + H_2 O$
Maltose . . . . $C_{12} H_{22} O_{11} + H_2 O$
(Roscoe.)

There are the same number of units of carbon and hydrogen in each sugar, and by oxidation they necessarily yield the same amounts of carbonic acid and water, and consequently produce the same amount of energy. There can be no difference in their action in *this* respect.

Amount of Heat Units.

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ALBERT C. GUBITZ.

Milk Sugar.

Is it true that human milk contains commercial milk sugar? Is it true that when commercial milk sugar is added to an infant food the sugar is in precisely the same condition as it exists in natural milk? Do we *know* that the sugar obtained from cow's milk is physiologically identical with the sugar existing in human milk? The caseins are different; the mineral salts are different; why then should it be taken for granted that the sugars are identical? A freshly made solution of milk sugar is different in some of its properties from a solution which has been allowed to stand for several hours. Tested by the polariscope the rotating power of a fresh solution of milk sugar is nearly double that of the *same* solution after standing. The solubility of different brands of commercial milk sugar varies. Pavy has shown that milk sugar obtained by treating the milk with rennet gives different reactions from those which occur in milk sugar obtained by the use of acetic acid. Commercial milk sugar is a chemical product; it is a waste product obtained from the whey which comes from cheese factories. The whey when sour is neutralized with lime or magnesia, and hence lactates of these bases are often found in the ash of the milk sugar.

Peculiarities of Milk Sugar.

Bacteria in Milk Sugar.

Professor Leeds states that in all his examinations of milk sugar obtained from drug stores, an abundant crop of bacteria developed when samples were submitted to the ordinary gelatin-peptone culture.

Dr. E. F. Brush says:—

Milk Sugar Eliminated.

"Sugar of milk in *human* milk is all assimilated, while the milk sugar of commerce, when added to baby's food, is eliminated both by the kidneys and bowels. This I have demonstrated by numerous experiments."

Maltose is assimilated without further change in the intestinal tract.

Maltose does not readily undergo acetous fermentation. (Fothergill.)

Maltose Preferable.

It (maltose) will *not* give rise to acidity and dyspepsia. (Dr. Mitchell Bruce.)

There is, therefore, not the slightest reason for thinking that milk sugar, for any reason, either theoretical or practical, is as desirable as maltose as a means of increasing the carbodydrates in milk.

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"*Ora et Labora.*"

TION OF COW'S MILK

ADAPT THE AMOUNT OF FAT

WHILE, on the one hand, the cow's milk must be so modified that the casein shall be reduced, the relative proportions of casein and albumen adjusted, the casein rendered soluble and digestible, the milk made alkaline and the deficiency of the carbohydrates overcome, the adaptation of the amount of fat, on the other hand, gives opportunity for greater consideration and can be determined only by the requirements, conditions and idiosyncrasies of the individual. When milk is modified by Mellin's Food all the fat must needs be supplied by the milk, since the Mellin's Food itself contains only an inconsiderable amount of fat derived from the grains used in its manufacture. An additional amount of fat, if required, may be obtained by the use of top milk or cream.

Fat to suit Condition.

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"He has carried every point who has mingled the useful with the agreeable."

THE ANTISCORBUTIC ELEMENT

IT is not sufficient that an infant's food should in its chemical composition be like mother's milk. Another requisite is quite as essential. To ensure healthy nutrition an infant food must contain the *antiscorbutic element*, and this antiscorbutic element can be found in fresh food only. **The persistent deprivation of fresh food is the most frequent direct cause of infantile scurvy.** Children fed on fresh milk — either cow's milk or breast milk — never have scurvy, unless in the case of artificially-fed infants the quantity of fresh milk is too small, or in the case of those fed at the breast, the mother is scorbutic.

Fresh Food prevents Scurvy.

"In no instance," writes Dr. W. B. Cheadle, "have I seen the disease arise in an infant at the breast, or when fed on an ample supply of good cow's milk. Experience shows that by desiccation milk loses some antiscorbutic property, and it would seem that its power of making red blood — its hæmic virtue — is in some degree impaired. Children brought up on dried foods alone, without any addition whatever, are apt to become pallid, deficient in robust vitality, and even rachitic. *A fresh animal element must be added.*" It must be remembered that it is milk that is fresh and *raw* that contains the antiscorbutic element. Sterilized

milk is not raw milk and is therefore not an antiscorbutic diet. The long process of heating to which it is necessarily subjected destroys the antiscorbutic element present in fresh milk, and renders it far less nutritious. Professor Leeds very tersely expresses the situation when he states that *the deaths due to malnutrition from feeding sterilized milk have exceeded a hundredfold those caused by disease germs in fresh milk.*

Dr. Cheadle's experience with sterilized milk is stated by him as follows: — "Although sterilized milk answers admirably for a time, children kept on it throughout eventually lose firmness of flesh and vigor, and do not thrive into robustness. I am convinced that the process [of sterilization] impairs the value of the nitrogenous element in some degree."

Mellin's Food and Fresh Milk an Antiscorbutic Diet.

There has not been discovered any tangible cause of scurvy. As far as we know, it is not caused by the *presence* of anything deleterious in the food, but rather by the *lack* of something — a lack of freshness, a lack of something which is in fresh milk but which is not in stale milk or in *cooked* milk. Fresh, raw, cow's milk contains the antiscorbutic element. It is, therefore, evident that a diet of Mellin's Food and milk and water is an antiscorbutic diet.

WHAT MELLIN'S FOOD ITSELF IS

Mellin's Food is a means to aid the physician in modifying fresh cow's milk.

Mellin's Food is a dry, soluble extract made from barley, malt and wheat.

Mellin's Food consists of maltose, dextrine, proteids and salts and is *entirely free* from starch and cane sugar.

Mellin's Food is the only true Liebig's Food.

Mellin's Food is not affected by either time or climate.

What Mellin's Food was, when first made, it is to-day.

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FORMULAS AND ANALYSES

AS an illustration of the wide range possible in the modification of cow's milk with Mellin's Food, we give a series of formulas which have been arranged with due regard to the limitations of the home. If the percentage of proteids in these seems greater than the proportion of proteids known to exist in cow's milk, when diluted with the given amount of water, it must be remembered that the proteids come not only from the casein of the cow's milk, but also from the *soluble* and *digestible* albumen of the Mellin's Food.

Soluble Proteids of Mellin's Food.

Realizing that it is not the child's age alone which determines the needed amounts of proteids, carbohydrates, salts or fat, but that other factors — strength, weight, vigor, etc. — exert their influences, we must not regard these formulas as cast-iron rules to be followed in modifying milk for children of different ages, but we must look upon them as guides in selecting the proper proportions. To the practitioner they will suggest other formulas, and will show that, when necessary, any desired proportion of constituents may be obtained by varying the proportions of the Mellin's Food, milk, cream and water.

Any Proportion Obtainable.

For Infants about Two Weeks Old.

Mellin's Food, 4 teaspoonfuls; Milk, 4¼ fluid ounces; Water, 11¾ fluid ounces.	Gives this Composition	Fat	1.01
		Proteids	1.12
		Carbohydrates (no starch)	2.01
		Salts	.23
		Water	95.63
			100.00

For Infants about One Month Old.

Mellin's Food, 5 teaspoonfuls (level); Milk, 5 fluid ounces; Water, 11 fluid ounces.	Gives this Composition	Fat	1.18
		Proteids	1.32
		Carbohydrates (no starch)	2.42
		Salts	.28
		Water	94.80
			100.00

For Infants about Six Weeks Old.

Mellin's Food, 5 teaspoonfuls (level); Milk, 6 fluid ounces. Water, 10 fluid ounces.	Gives this Composition	Fat	1.41
		Proteids	1.56
		Carbohydrates (no starch)	2.69
		Salts	.32
		Water	94.02
			100.00

For Infants about Two Months Old.

Mellin's Food, 6 teaspoonfuls (level); Milk, 6½ fluid ounces; Water, 9½ fluid ounces.	Gives this Composition	Fat	1.53
		Proteids	1.69
		Carbohydrates (no starch)	3.03
		Salts	.35
		Water	93.40
			100.00

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For Infants about Three Months Old.

Mellin's Food, 1 tablespoonful (heaping); Milk, 8 fluid ounces; Water, 8 fluid ounces.	Gives this Composition	Fat	1.86
		Proteids	2.08
		Carbohydrates (no starch)	3.82
		Salts	.44
		Water	91.80
			100.00

For Infants about Three Months Old. (Rich milk.)

Mellin's Food, 1 tablespoonful (heaping); Rich Milk, 8 fluid ounces; Water, 8 fluid ounces.	Gives this Composition	Fat	2.13
		Proteids	1.99
		Carbohydrates (no starch)	4.19
		Salts	.51
		Water	91.18
			100.00

For Infants about Four Months Old.

Mellin's Food, 10 teaspoonfuls (level); Milk, 9½ fluid ounces; Water, 6½ fluid ounces.	Gives this Composition	Fat	2.19
		Proteids	2.47
		Carbohydrates (no starch)	4.60
		Salts	.52
		Water	90.22
			100.00

For Infants about Five Months Old.

Mellin's Food, 13 teaspoonfuls (level); Milk, 10½ fluid ounces; Water, 5½ fluid ounces.	Gives this Composition	Fat	2.40
		Proteids	2.75
		Carbohydrates (no starch)	5.42
		Salts	.59
		Water	88.84
			100.00

For Infants about Six Months Old.

Mellin's Food, 2 tablespoonfuls (heaping); Milk, 12 fluid ounces; Water, 4 fluid ounces.	Gives this Composition	Fat	2.72
		Proteids	3.14
		Carbohydrates (no starch)	6.35
		Salts	.68
		Water	87.11
			100.00

For Infants about Six Months Old. (*Rich milk.*)

Mellin's Food, 2 tablespoonfuls (heaping); Rich Milk, 12 fluid ounces; Water, 4 fluid ounces.	Gives this Composition	Fat	3.10
		Proteids	3.00
		Carbohydrates (no starch)	6.90
		Salts	.79
		Water	86.21
			100.00

For Infants about Six Months Old. (*Top milk.*)

Mellin's Food, 2 tablespoonfuls (heaping); Top Milk, (upper half of milk after standing 4 hours) 12 fluid ounces; Water, 4 fluid ounces.	Gives this Composition	Fat	4.04
		Proteids	3.04
		Carbohydrates (no starch)	6.73
		Salts	.77
		Water	85.42
			100.00

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Low Proteids.

Mellin's Food, 2 tablespoonfuls (heaping); Milk, 4 fluid ounces; Cream, 1½ tablespoonfuls; Water, 12 fluid ounces.	Gives this Composition	Fat	2.50
		Proteids	1.45
		Carbohydrates (no starch)	4.18
		Salts	.37
		Water	91.50
			100.00

Low Proteids and Low Carbohydrates.

Mellin's Food, 11 teaspoonfuls (level); Top Milk, (upper half of milk after standing 4 hours) 6 fluid ounces; Water, 10 fluid ounces.	Gives this Composition	Fat	2.25
		Proteids	1.58
		Carbohydrates (no starch)	4.07
		Salts	.42
		Water	91.68
			100.00

High Fat and Low Proteids.

Mellin's Food, 3 tablespoonfuls (heaping); Milk, 4 fluid ounces; Cream, 2 tablespoonfuls; Water, 12 fluid ounces.	Gives this Composition	Fat	3.00
		Proteids	1.65
		Carbohydrates (no starch)	5.54
		Salts	.45
		Water	89.36
			100.00